WHAT IS CLAIMED IS:

1. A signal processing system capable of compensating for the channel response characteristics of an input waveform, comprising:

input specifications for specifying the design of a filter, including:

channel response characteristics defining the response characteristics of a channel used to acquire said input waveform; and

user specifications for specifying a desired frequency response and a degree of compliance to the desired frequency response;

a filter builder for generating coefficients for said filter and outputting final performance specifications, having:

a compensation filter generator for generating coefficients corresponding to a compensation response on the basis of the inverse of the channel response characteristics; and

a response filter generator for generating coefficients corresponding to a combination of an ideal response and a noise reduction response on the basis of the user specifications; and

said filter for filtering said input waveform and outputting an overall response waveform having said desired frequency response, comprising:

a filter coefficient cache for storing the coefficients generated by said filter builder;

a compensation filter portion for filtering said input waveform using the coefficients stored in said filter coefficient cache corresponding to said compensation response; and

a response filter portion having a response filter stage and a noise reduction stage for filtering the compensated waveform output from said compensation filter portion and outputting said overall response waveform; said response filter portion filtering using the coefficients stored in said filter coefficient cache corresponding to said combination of said ideal response and said noise reduction response.

2. The signal processing system according to claim 1, wherein said filter is implemented as an infinite impulse response (IIR) filter.

3. The signal processing system according to claim 1, wherein said filter is implemented as a finite impulse response (FIR) filter.

4. The signal processing system according to claim 1, wherein said channel response characteristics are predetermined based on a reference signal and the reference signal as acquired by said channel.

5. The signal processing system according to claim 1, wherein said user specifications comprise a bandwidth, a response optimization, a compensation compliance, and a filter implementation type.

6. The signal processing system according to claim 5, wherein said response optimization is a pulse response optimization implemented using a Besselworth filter.

7. The signal processing system according to claim 5, wherein said response optimization is a noise performance optimization implemented using a Butterworth filter.

8. The signal processing system according to claim 5, wherein said response optimization is a flatness optimization implemented using a Butterworth filter.

9. The signal processing system according to claim 5, wherein said filter implementation type is finite impulse response (FIR) or infinite impulse response (IIR).

10. The signal processing system according to claim 1, wherein said user specifications default to predetermined values.

11. A signal processing element for filtering an input digital waveform, comprising:

a filter builder for generating filter coefficients on the basis of a channel frequency response and a user response characteristics; said channel frequency response being determined on the basis of a response input and a correction input;

an infinite impulse response (IIR) filter having an IIR input for said input digital waveform and an IIR coefficient input connected to said filter builder; said IIR filter producing an IIR filtered waveform from the input digital waveform on the basis of the filter coefficients generated by said filter builder;

a finite impulse response (FIR) filter having an FIR input for said input digital waveform and a FIR coefficient input connected to said filter builder; said FIR filter producing a FIR filtered waveform from the input digital waveform on the basis of the filter coefficients generated by said filter builder; and

an output selector switch for selecting either said IIR filtered waveform or said FIR filtered waveform for output.

12. The signal processing element according to claim 11, wherein said filter builder detects changes in the sampling rate of said input digital waveform that require the filter coefficients to be generated.

13. The signal processing element according to claim 11, wherein said filter builder generates filter coefficients for said FIR filter or said IIR filter on the basis of said output selector switch.

14. The signal processing element according to claim 11, wherein said filter builder has channel, compensation, shaper, and noise reduction outputs for evaluating the performance of the filtering.

15. The signal processing element according to claim 11, wherein said response input is a known input response and said correction input is a measured input response as acquired by an input channel.

16. The signal processing element according to claim 11, wherein said user response characteristics are used to generate filter coefficients corresponding to an arbitrary response portion of the filter.

17. The signal processing element according to claim 11, wherein said user response characteristics comprise a bandwidth, a response optimization, a compensation compliance, and a filter implementation type.

18. The signal processing element according to claim 17, wherein said response optimization is a pulse response optimization implemented using a Besselworth filter.

19. The signal processing element according to claim 17, wherein said response optimization is a noise performance optimization implemented using a Butterworth filter.

20. The signal processing element according to claim 17, wherein said response optimization is a flatness optimization implemented using a Butterworth filter.

21. The signal processing element according to claim 17, wherein said filter implementation type is FIR or IIR.

22. The signal processing element according to claim 11, wherein said user response characteristics default to predetermined values.

23. A method of filtering an input digital waveform to compensate for the response characteristics of an acquisition channel, comprising the steps of:

generating a compensation portion of a filter on the basis of an input channel response, using the steps of:

pre-warping said input channel response;

designing an analog filter emulating the pre-warped input channel response by making an initial filter guess and iterating the coefficients of said initial filter guess to minimize a mean-squared error;

inverting said analog filter; and

digitizing the inverted analog filter to produce said compensation portion of said filter using a bilinear transformation; and

filtering said input digital waveform using said compensation portion of said filter.

24. The method according to claim 23, further comprising the step of generating an arbitrary response portion of said filter on the basis of an input user specifications, wherein said input digital waveform is filtered using said arbitrary response portion of said filter, thereby producing a filtered digital waveform having the desired response characteristics.

25. The method according to claim 24, wherein said input user specifications comprise a bandwidth, a response optimization, a compensation compliance, and a filter implementation type.

26. The method according to claim 24, wherein said arbitrary response portion of said filter comprises a shaper and a noise reducer.

27. The method according to claim 24, wherein said input user specifications default to predetermined values.

28. The method according to claim 23, wherein said filter is implemented as an infinite impulse response (IIR) filter.

29. The method according to claim 23, wherein said filter is implemented as a finite impulse response (FIR) filter.

30. The signal processing system according to claim 23, wherein said input channel response is predetermined based on a reference signal and the reference signal as acquired by said channel.

31. The method according to claim 23, wherein said response optimization is a pulse response optimization implemented using a Besselworth filter.

32. The method according to claim 23, wherein said response optimization is a noise performance optimization implemented using a Butterworth filter.

33. The method according to claim 23, wherein said response optimization is a flatness optimization implemented using a Butterworth filter.

34. The method according to claim 23, wherein said filter implementation type is FIR or IIR.

35. The method according to claim 23, wherein the coefficients of said initial filter guess are iterated until said mean-squared error is less than a compensation compliance specified in said input user specifications.